AVR® STK100 Starter Kit User Guide

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ATMEL®

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Section 1

Introduction

1.1 AVR STK100 Starter Kit

The STK100 Starter Kit is designed to support the AVR Microcontroller from Atmel Corporation. The system will help tiny AVR users to get started designing with AVR Microcontrollers.

The STK100 incorporates an In-System Programming unit and an applications board.

For late breaking news and any manual errata always check the README.TXT file included with the software or check the Atmel web site for any updates.

1.2 Device Support

The system software currently has support for the following devices.

- ATtiny10
- ATtiny11
- ATtiny12
- ATtiny15
- ATtiny22
- ATtiny28
- AT90S2343

Upgrades for new devices will be available via the Internet at *www.atmel.com.*

Section 2

Getting Started

2.1 Unpacking the System

You will find the following items in the pack:

- STK100 main board
- 1 disk set
- Parallel/printer port cable
- ATtiny11 sample + AT90S2343
- Atmel CD-ROM

2.2 System Requirements

The minimum computer hardware and software requirements are:

- 80486 processor or above
- 16 MB RAM
- 2 MB free hard disk space
- Windows 95/98 or Windows NT

2.3 Power Supply

9.5 - 15-volt DC power supply with 3.5 mm barrel connector, center positive or 7 - 13-volt AC power supply with 3.5 mm barrel connector.

Note: If the regulator or other IC runs too hot, reduce the input voltage. The specially formulated ink used on the STK100 will turn darker if subjected to heat to indicate hot spots. It will turn lighter when the heat source is removed.

2.4 Connecting the System

The system has two separate connections to the PC either of which may be used for running or programming Tiny AVR devices on the STK100. The connectors for serial and parallel port are next to each other on the STK100 board.

The two connections are serial 9-pin “D” connector connecting to the serial port or parallel 25-pin “D” connector connecting to the parallel/printer port. The programmer software must be configured for the correct connection. This is described in Section 6, “How to Use the Software”.

Note that in order to update the internal firmware on the STK100 for new device support, the system **must** be connected to the parallel port.

In order to receive free updates, register at:

www.atmel.com/products/avrrisc/register/

Updates will be added to the Atmel web site as new parts become available.

A parallel port cable is supplied with the system to allow this port to be used for upgrades. If you prefer to use the serial port, a straight-through serial cable is required. Do not use a null-modem cable with crossed connections.

The software must be configured for either serial or parallel port operation, and the correct port chosen: LPT1, COM1, etc. See Section 6, “How to Use the Software” for details.

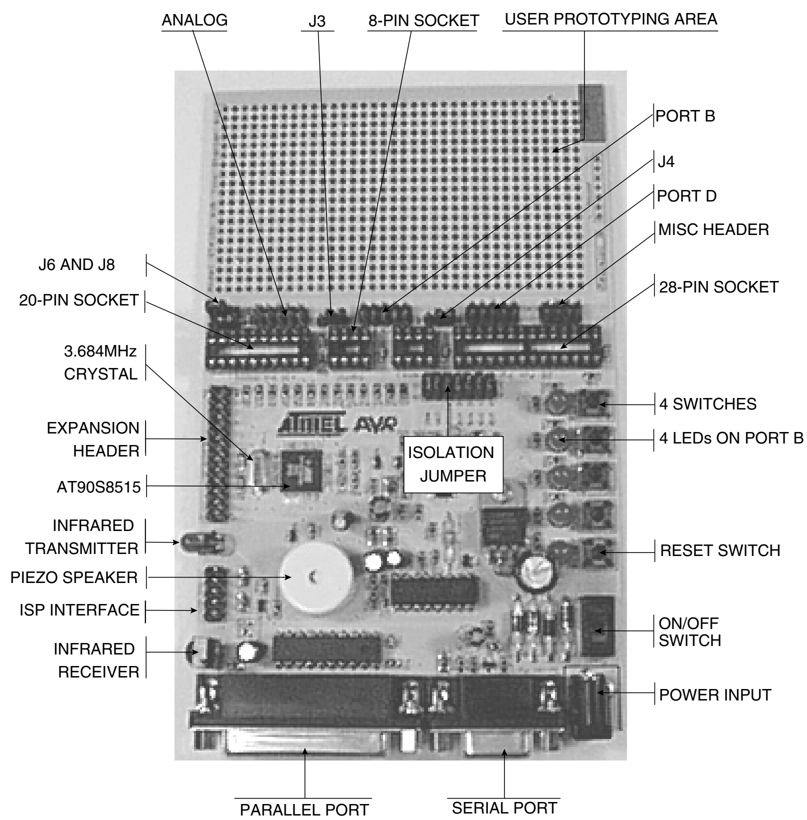
Please read the next section, “Hardware Description”, before using the programmer in STK100.

Section 3

Hardware Description

The main features of the board are shown in the diagram below.

Figure 3-1.



3.1 Hardware Specifications

Serial Port:	Full duplex, 8 bits, no parity, running at 9600 baud
Parallel Port:	Buffered synchronous interface
Supply Rail:	Fully variable from 0 - 4.7 volts (set from PC)
Analog Supply Rail:	As above, but isolated and filtered

Supply Current Limit:	150 mA (approx.) independent of V_{CC} setting
V_{PP} Supply:	12 volts up to 10 mA
Brownout:	Tracking brownout triggers when V_{CC} drops below 0.4V of previous V_{CC} setting
Supply:	>9.5 volts DC input center positive
	>7 volts AC
	Max supply $15V_{DC}$ or $13V_{AC}$
	Input via 3.5 mm barrel connector
Oscillator:	3.684 MHz crystal
General User I/O:	Four low-current LEDs connected together with four user switches
Infrared Interface:	Receiver/demodulator with digital output (30 m range)
	Transmitter modulated by AVR ATtiny28 only, active current limited
Sound:	Piezo speaker with transistor amplification, AC coupled
Size:	Standard Eurocard size 160 mm x 100 mm to enable installation in a standard case
User Matrix Area:	0.1" pitched holes in a 35 x 21 hole pattern
Keypad Connector:	10-key matrixed keypad connection
ISP Connector:	Standard Atmel In-System Programming interface
Expansion Connector:	For connection of external programming systems
Device Sockets:	Four 1 x 28-pin, 1 x 20-pin and 2 x 8-pin
Port Headers:	Three 2 x 10-pin and 1 x 8-pin

Section 4

Device and Jumper Information

Please refer to Figure 9-2, “Targets and Interfaces Schematic”, found in Section 9, “Appendix A – STK100 Schematics”.

The system has four sockets for devices:

- 28-pin socket
- 20-pin analog socket
- 8-pin digital socket
- 8-pin analog socket

These sockets have been configured to accept all of the current and future AVR Tiny devices. Please choose the correct socket for the device to program.

The STK100 features two types of programming. It will use either low-voltage In-System Programming (ISP) or high-voltage parallel programming, depending on the part. Therefore, it is essential that the user inserts the device into the correct socket and chooses the correct device type from the programming menu on the PC. Failure to do so may result in damage to the device and possibly the system.

4.1 Device Orientation

Before programming a device using the programming module, the device must be inserted correctly into the programming unit. The AVR device itself has an arrow printed on it, which points towards pin 1 of the device. Below are the three types of sockets and their orientation.

Figure 4-1. 8-pin Devices

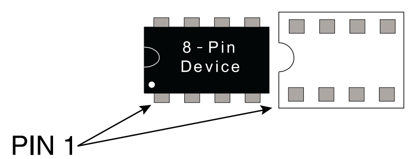


Figure 4-2. 20-pin Devices

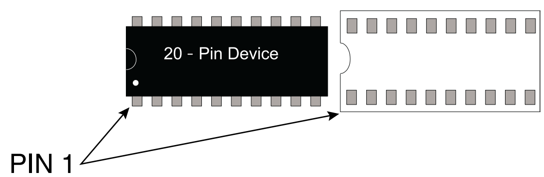
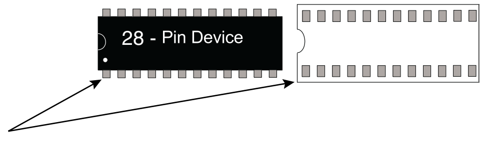


Figure 4-3. 28-pin Devices



There is another method of checking that the device is inserted the right way and that is to check the notches on both the device and the programming socket. At the end of the device a notch is cut out. There is also a notch cut out on the device socket, which is also printed on the board. The notch on the device must correspond with the notch in the socket.

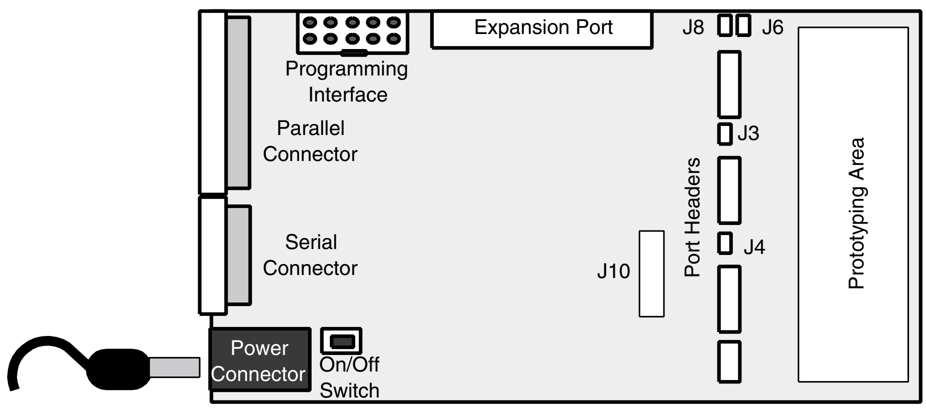
The orientation of the device is vitally important. If you insert the device in the wrong way, it may be damaged. **Do not plug a device in with the power switched on: it may damage it.** Similarly, never remove the device while the power is on.

Note: Do **not** insert a device in more than one socket at a time. Otherwise, programming errors will occur.

4.2 Jumpers

In addition to the sockets, there are user-accessible jumpers. J3, J4, J6 and J8 are used to enable the additional I/O ports that are available on some devices. The jumper next to each socket should be set towards pin 1 marked on the schematic for programming a device using the socket, and then moved across towards pin 3 to run.

Figure 4-4. STK100 Starter Kit



4.3 The Function of the Jumpers

4.3.1 J3

This jumper is adjacent to Socket 3 8-pin digital part and is used to select program set towards pin 1 or run set towards pin 3. When in run mode it will enable Port PB5 and will route it to the port B 10-pin header.

4.3.2 J4

This jumper is adjacent to Socket 4 8-pin analog part and is used to select program set towards pin 1 or run set towards pin 3. When in run mode it will enable Port PB5 and will route it to the port B 10-pin header.

4.3.3 J6

This jumper is adjacent to Socket 2 20-pin part and is used to select the system clock during programming when set towards pin 1. To run, set it towards pin 3, which will allow the port pin to be used as I/O bit PB5/ADC8.

4.3.4 J8

This jumper is adjacent to Socket 2 20-pin part and is used to select program set towards pin 1 or run set towards pin 3. When in run mode it will enable Port PB7/ADC10 and will route it to the port B 10-pin header.

There are also additional jumpers that can be used for special functions.

4.3.5 J10

Isolation jumpers. These jumpers are used to isolate the on-board peripherals on the system so the user can use the port pins in their circuits.

4.3.6 Functions

Bit 0 - Bit 3	Used to disable relevant switch/LED combinations I/O
Sound	Used to disable speaker circuit output only
IRT	Used to disable infrared transmitter output only
IRR	Used to disable infrared receiver input only

Note: Remove the jumper to disable the circuit.

4.4 Headers

There are various signals brought out for convenience from the circuit which the user can access. These connectors are adjacent to the prototyping area. Note that the pin numbers are screened onto the overlay.

Figure 4-5. 10-pin Connector

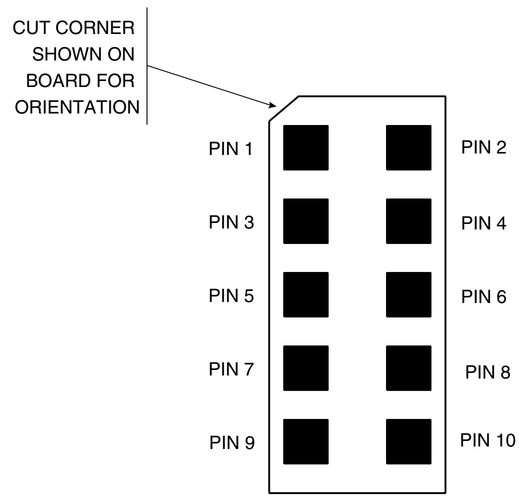
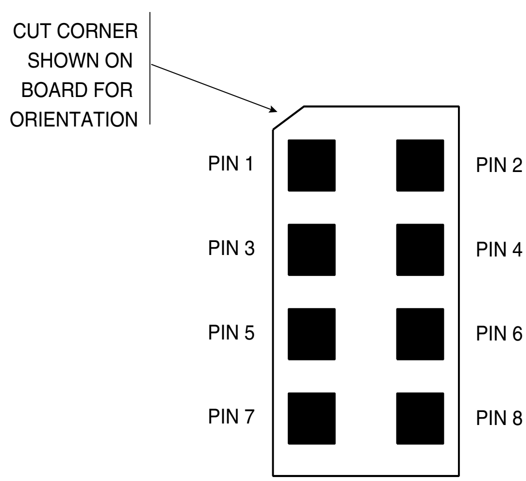


Figure 4-6. 8-pin Connector



4.5 User Interface Headers

4.5.1 J2

Matrixed Keypad Interface: This is wired directly to the 28-pin device (see *www.avr-forum.com* for keypad details).

4.5.2 J5

Miscellaneous: These are miscellaneous signals that can be used in conjunction with the port headers (see below). The signals are:

Pin 1:	PA0 on 28-pin part
Pin 2:	PA1 on 28-pin part
Pin 3:	Demodulated infrared receiver input (PA3) on 28-pin part
Pin 4:	Modulated infrared transmitter output (PA2) on 28-pin part
Pin 5:	Buffer enable can be used to enable external isolation buffer during programming (active low during programming)
Pin 6:	Reset input from user circuit (open collector or pull-down only)
Pin 7:	Ground
Pin 8:	V_{CC}

4.5.3 J7

Port D: These are the port D signals from 28-pin and 20-pin parts.

Pin 1:	PD0
Pin 2:	PD1
Pin 3:	PD2
Pin 4:	PD3
Pin 5:	PD4
Pin 6:	PD5
Pin 7:	PD6
Pin 8:	PD7
Pin 9:	Ground
Pin 10:	V_{CC}

4.5.4 J9

Port B: These are the port B signals from all parts.

Pin 1:	PB0
Pin 2:	PB1
Pin 3:	PB2
Pin 4:	PB3
Pin 5:	PB4 (AD7 input on 20-pin part)
Pin 6:	PB5 (AD8 input on 20-pin part)
Pin 7:	PB6 (AD9 input on 20-pin part)
Pin 8:	PB7 (AD10 input on 20-pin part)
Pin 9:	Ground
Pin 10:	V_{CC}

4.5.5 J11

Analog: These are the analog inputs (port A) on the 20-pin part and 8-pin analog part.

Pin 1:	PA0 (AD1 input on 8-pin part)
Pin 2:	PA1
Pin 3:	PA2

Pin 4: PA3 (AD2 input on 8-pin part)
Pin 5: PA4 (AD3 input on 8-pin part)
Pin 6: PA5 (AD0 input on 8-pin part)
Pin 7: PA6
Pin 8: A/D reference input
Pin 9: Analog ground
Pin 10: Analog supply rail

Note that additional analog inputs are available on the port B connector as shown in parentheses on the port B connection table.

Finally, there are two expansion connectors that can be used to drive external circuits.

4.5.6 J13

ISP Connector: This will be used to enable the user to program external devices in circuit using the system. It conforms to the standard Atmel ISP pinout.

4.5.7 J12

Expansion Connector: For future use.

4.6 Notes on Usage

1. It is advisable to disconnect all user circuitry when attempting to program as it may override the programming control signals and prevent a successful programming session.
2. Attempting to draw more than 150 mA of current from V_{CC} will invoke the current-limiting circuit.
3. Users are advised not to input signals larger than the V_{CC} setting to any device pin as it may damage the device and/or the starter kit hardware.
4. In order to supply the maximum flexibility, the LEDs and switches have been connected together. The design is such that if the port DDRx register is set to input (0), then the LED will be turned off and the input will be a 1. If the switch is pressed, then the LED will light for as long as the switch is pressed and will extinguish when released. When the switch is pressed, the input on the port will be a 0. If the DDRx register bit is set to output (1), then sending a 0 out on the port will turn the LED on and a 1 will turn it off. Note that the circuit is arranged so the LED is brighter when the switch is pressed than when it is pulled low by the device. It is possible to both read the switch and write to the LED by careful manipulation of the DDRx register (set it to output for most of the time and briefly switch to input when a switch read is required).
5. The infrared transmitter is modulated by the device and is driven directly. The receiver has a built-in demodulator and provides a direct digital signal to the device.
6. The keypad interface was designed for a 10-key matrixed keypad and uses the multiplexed keypad interface on the 28-pin device.
7. Ensure the jumper next to the socket being used is set to Program or Run, as required.
8. Programming low-voltage parts: Some 3.3-volt parts may need 5V programming voltages, even though they run at lower voltages. We recommended that all peripheral jumpers (J10) are removed to isolate user circuits before programming the device.

Section 5

Installing the Software

5.1 Windows 95/98 & Windows NT

Check web site *www.atmel.com* for the latest updates before installing the software.

To install the software please insert the supplied disk or CD-ROM in your computer and perform the following steps:

- Click on your “Start” button.
- Select “Settings”.
- Select “Control Panel”.
- Choose “Add/Remove Programs”.
- Click the “Install” button.
- Follow on-screen prompts.

The software will then be installed onto your computer and an icon will be added to your “Start” menu.

This software does not support Windows 3.11 as it is a 32-bit application.

Note: In the unlikely event that you have any problems installing the software or suspect that you have faulty media please contact our technical support department for advice. Please make sure you have the latest version of the software installed before contacting the support line.

See Section 8, “Technical Support” for more information.

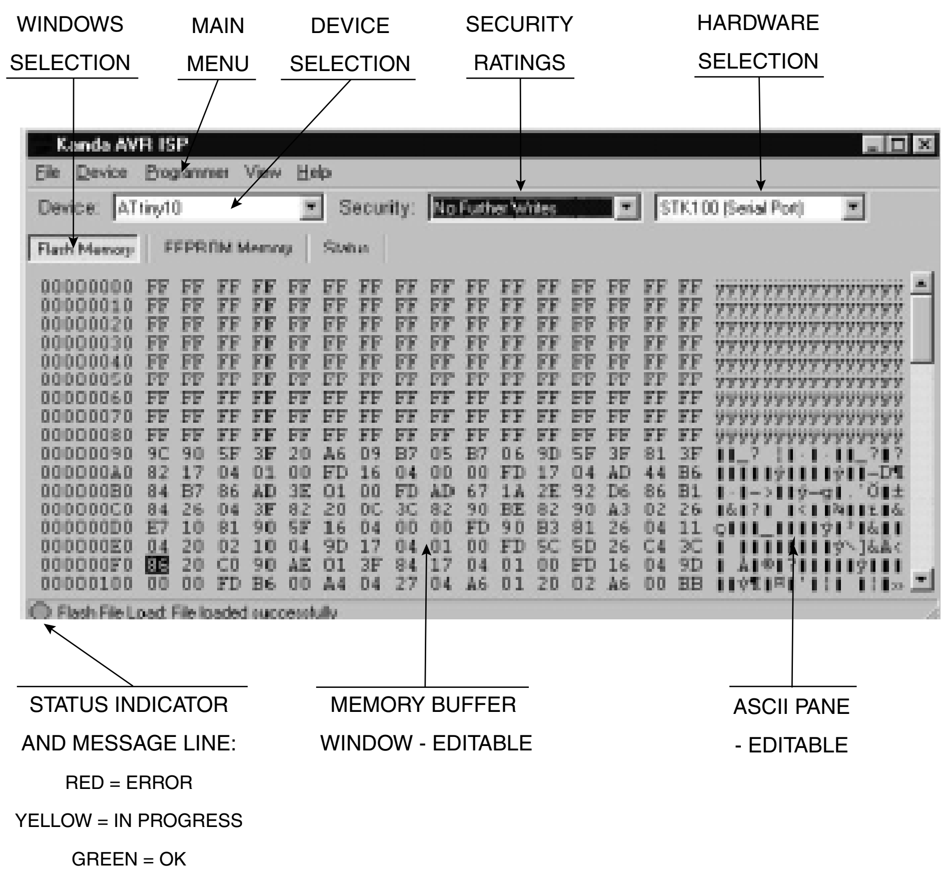
![ATMEL logo]

Section 6

How to Use the Software

The programmer software is shown below:

Figure 6-1.



6.1 Overview

The programmer uses three main displays – Flash Memory, EEPROM Memory and Status. Data and information are displayed on these three screens, which are selected by a mouse-click on the appropriate button. The main menu gives file and programmer operations and the configuration information is shown just below the menu bar. A status indicator at the bottom of the screen shows whether an operation was successful – a red light means that an error has occurred. All menu choices can be selected by using the mouse or pressing the Alt key with the underlined letter in the menu item.

6.2 Configuring the Software

1. The first step is to choose the type of hardware connection, using the drop-down list at the top right of the screen. Choose STK100 (serial port) or STK100 (parallel port), depending on your requirements. Ensure that the board is connected to the correct port – serial or parallel.
2. Now select the "Programmer - Options" menu choice. A dialog box appears where you can pick the correct port setting. If parallel port had been selected in stage 1, then this dialog box gives parallel port choices (LPT1, LPT2, LPT3); otherwise, it gives serial port choices (COM1, COM2, COM3, COM4).
3. Next, select the required device in the drop-down list at the top left of the screen. The memory sizes, fuse availability and other device-specific features are set automatically.
4. Set the level of programming security required in the third drop-down list in the center of the screen.

6.3 Loading Data

1. To load data to be programmed, choose the "File - Load" menu choice. A further menu fly-out allows you to select Flash or EEPROM memory as the target for the load operation.

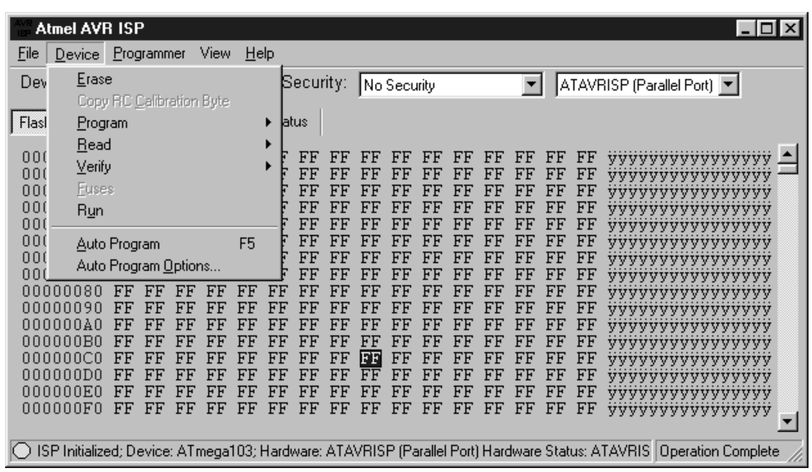
Note: Only Intel hex files can be used.

2. Select the file and it will be opened in the correct buffer window. If an error occurs during the load operation because the file cannot be found, the file is not Intel hex, the file is too big, etc., then the status light at the bottom left of the screen turns red and a warning message is displayed. If the operation was successful, this indicator light stays green. The light is yellow when the operation is taking place – this behavior is the same for all operations. Clicking the mouse on the error message opens the status window where more information may be given.
3. When a file has been loaded into the Flash memory, and the EEPROM memory if required, the programmer is ready for programming operations. EEPROM data (or Flash data) can be typed directly into the buffer windows instead of being loaded from a file. The data can be entered as ASCII characters or as hexadecimal numbers.

6.4 Programming

The programming operations are listed in the "Device" menu. The programmer must be configured before programming can be undertaken, and for the program operation, data must be loaded into the buffer windows.

Figure 6-2.



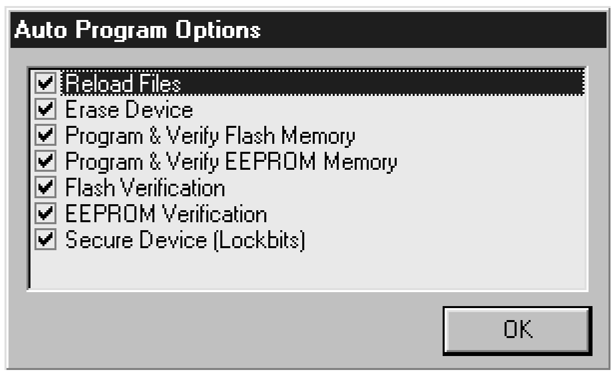
6.4.1 The Four Different Operations

- Erase device: The device is erased and code and EEPROM memories will be empty – blank value is FFh. All fuse settings will be cleared to default values (see data book/CD-ROM for device-specific fuse information).
- Program device: Choose “Flash”, “EEPROM”, “Lockbits” or “Fuses” on the fly-out menu. If “Flash” or “EEPROM” is chosen, then that part of the device is programmed with the contents of the Flash or EEPROM buffer window, respectively. If “Lockbits” is selected, the security bits are programmed according to the security settings drop-down list described above. If “Fuses” is chosen, a dialog box appears with the fuses available on the selected device. Set the fuses to your requirements.
- Read device: If “Flash” or “EEPROM” is selected, the contents of the device memory selected is uploaded and displayed in the relevant buffer window. If the device is blank, then all locations will read as FFh. If the security (lock)bits are set, then the data will be invalid. Selecting “Fuses” displays the status of the fuses on the selected device in a list box.
- Verify device: The contents of the selected memory area (Flash or EEPROM) on the device is compared with the contents of the equivalent buffer window and any differences are shown in red – correct values are shown in green.

It is suggested that, for most programming sessions, Auto Program be used.

Choose “Auto Program Options” to set the required programming operations. A list of operations (Erase, Program Flash, fuse bits, etc.) is displayed:

Figure 6-3.



Check the operations required (v = on) and all the chosen operations will be carried out when Auto Program (F5) is used. If “Program Fuses” is checked, then another dialog box will appear, after this list is closed, where the device-specific fuses can be set.

Note: It is advisable to erase the device before programming unless you are adding extra data to existing data in the device. You will not be able to program the device if the write lockbit has been set without first erasing it.

6.5 Warning

Setting lockbits may mean that you will be unable to perform further verification on the device, and disable further writing to the device. You will, however, be able to re-use the device if you perform an erase.

Section 7

Menu and Option Descriptions

7.1 File Menu

7.1.1 Load — Select Memory Area/buffer window to load (Flash or EEPROM), then open the “Intel Hex” file in the “Open File” dialog box. A red status warning light indicates that the file load was unsuccessful. This may be because the file is not Intel hex or it is too large for the selected buffer/memory.

7.1.2 Save — Saves the contents of the selected buffer (Flash or EEPROM) to file. Choose a filename in the “File Save” dialog box that appears.

7.1.3 Reload — Reloads the buffer (Flash or EEPROM) with the last file opened.

7.1.4 Exit — Quits the program. Standard Windows close choices can also be used to exit the program.

7.2 Device Menu

7.2.1 Erase — The whole device is erased.

7.2.2 Program — The selected device memory, fuses or lockbits are programmed.

7.2.3 Read — The selected device memory or fuses are read.

7.2.4 Verify — The selected device memory is verified against the buffer contents.

7.2.5 Run — Takes target device out of programming mode and into normal run mode. The user will be prompted to switch jumpers to run mode.

7.2.6 Fuses — Presents the user with a list of available programmable fuses on the device and allows the user to write and read these fuses if the device supports the program.

7.2.7 Auto Program — All operations selected in the “Auto Program Options” are carried out.

7.2.8 Auto Program Options — Dialog box to set required programming operations that will be carried out sequentially when “Auto Program” is pressed.

7.3 Programmer Menu

7.3.1 Options Dialog box for port selection. You must choose parallel or serial port operation and the correct product (STK100) first, using the drop-down list at the top right of the screen.

7.3.2 Information Shows information about the programmer state (e.g. hardware detected), which port, etc.

7.4 View Menu

7.4.1 Flash The Flash Memory buffer window is displayed.

7.4.2 EEPROM The EEPROM Memory buffer window is displayed.

7.4.3 Status The Status window is displayed. This lists all operations, error messages, and status information that have been posted during this session.

7.5 Help Menu

7.5.1 About Version and program information

7.6 Other Controls

7.6.1 Device Selector Located at the top left of the screen, this drop-down list is used to select the required device. Make sure that this selection matches the device you have plugged into the board. Obtain upgrades to support new devices as they are released.

7.6.2 Security Located in the center of the screen, security is used to select type of access to the device once it has been programmed. This is done by programming the lockbits, so ensure that the lockbits are checked in the "Device - Auto Program Options" if you want security set on the device, or choose "Device - Program - Lockbits" for manual programming.

7.6.3 Hardware Selection Located at the top right of the screen, the hardware selection must be set to one of the STK100 options – serial or parallel port. Which serial or parallel port is used is set in the "Programmer - Options" menu. Ensure that the STK100 board is connected to the correct port.

7.6.4 Window Selection Located below the device selector, these three buttons indicate which display is visible – Flash buffer window, EEPROM buffer window or the Status window. Whichever display is active can also be selected using the "View" menu.

7.6.5 Flash Buffer Window Displays the Flash memory in a buffer window. The code to be programmed into the device is loaded into this buffer by the "File - Load - Flash" option, or read from the device by the "Device - Read - Flash" option. The size of the buffer changes to mirror the Flash memory size on the selected device. If "Device - Verify - Flash" is used, the contents of this buffer are compared with the contents of the Flash (code) memory on the device. Locations that match are shown in green, mis-matches are shown in red. The data in this buffer window can be changed or entered as either hexadecimal numbers or

ASCII characters. Holding the mouse cursor over a value brings up a fly-out that gives the address and the value in decimal, binary, hexadecimal and ASCII.

7.6.6 EEPROM Buffer Window

Displays the EEPROM memory in a buffer window. The code to be programmed into the device is loaded into this buffer by the “File - Load - EEPROM” option, or read from the device by the “Device - Read - EEPROM” option. The size of the buffer changes to mirror the EEPROM memory size on the selected device. If “Device - Verify - EEPROM” is used, the contents of this buffer are compared with the contents of the EEPROM memory on the device. Locations that match are shown in green, mis-matches are shown in red. The data in this buffer window can be changed or entered as either hexadecimal numbers or ASCII characters. Holding the mouse cursor over a value brings up a fly-out that gives the address and the value in decimal, binary, hexadecimal and ASCII.

7.6.7 Status Window

This window lists all the operations, status and error messages that have happened during the current session.

7.6.8 Status Indicator

Gives a visual result of the current operation – red means that the operation failed, yellow means it is in progress and green means it was successful. Further information is given in the accompanying message. These messages are listed in the Status window.

Section 8

Technical Support

8.1 General

A variety of technical support and user help is available to support the STK100 and AVR devices in general.

When contacting Technical Support please specify which starter kit you require support on – STK100, in this case. You may be asked for your registration details, so please register the product. See below for registration details.

Telephone Number:	+44 (0) 1970 621049
Fax Number:	+44 (0) 1970 621040
e-mail:	stk_support@atmel.com

We recommend that, unless your query is very simple or urgent, you use e-mail as the preferred method of contacting Technical Support. This allows you to supply us with full details of the problem.

If your problem is related to the PC connections, then please advise us of the PC type (e.g. laptop, desktop), speed and operating system, software version shown in "About" menu choice and whether you are using the serial or parallel port.

For general information on Atmel, AVR devices or other Atmel products, log on to

www.atmel.com.

For information on AVR devices, code examples, application notes, frequently asked questions (FAQs), distributor lists and AVR resources, log on to

www.avr-forum.com.

This web site also features the AVR chat forum, where you can obtain help and advice from other AVR users. This is not an official Atmel site, but it is endorsed by Atmel.

8.2 Registration

In order to receive updates you must be registered.

See *www.atmel.com/products/avrrisc/register/.*

Software updates will be added to the Atmel web site and AVR-forum web site as new parts become available.

8.3 EMC Regulations

This system has been tested to ensure that it complies with the latest regulations for EMC susceptibility and emissions. Although the system has been tested, it is a demonstration board and the user will modify the board to his/her requirements, therefore the EMC characteristics of the board will not remain constant. The board has been designed to minimize electromagnetic radiation, but due to the open framework and user interface, it is not advisable to rely on an absence of EMI radiation when using this board.

Atmel cannot be held accountable for any user-supplied equipment, such as power supplies and computers, used with this system. If these parts do not conform to the EMC regulations, then the complete system will not conform to the standards.

The same proviso applies to any user circuitry connected to this system, such as test boards and modules. If any changes are made to the hardware supplied with this system, such as a change in the crystal frequency or modifications to tracks or layouts, then the system will not conform to the regulations.

Section 9

Appendix A – STK100 Schematics

Figure 9-1. Main Logic Schematic

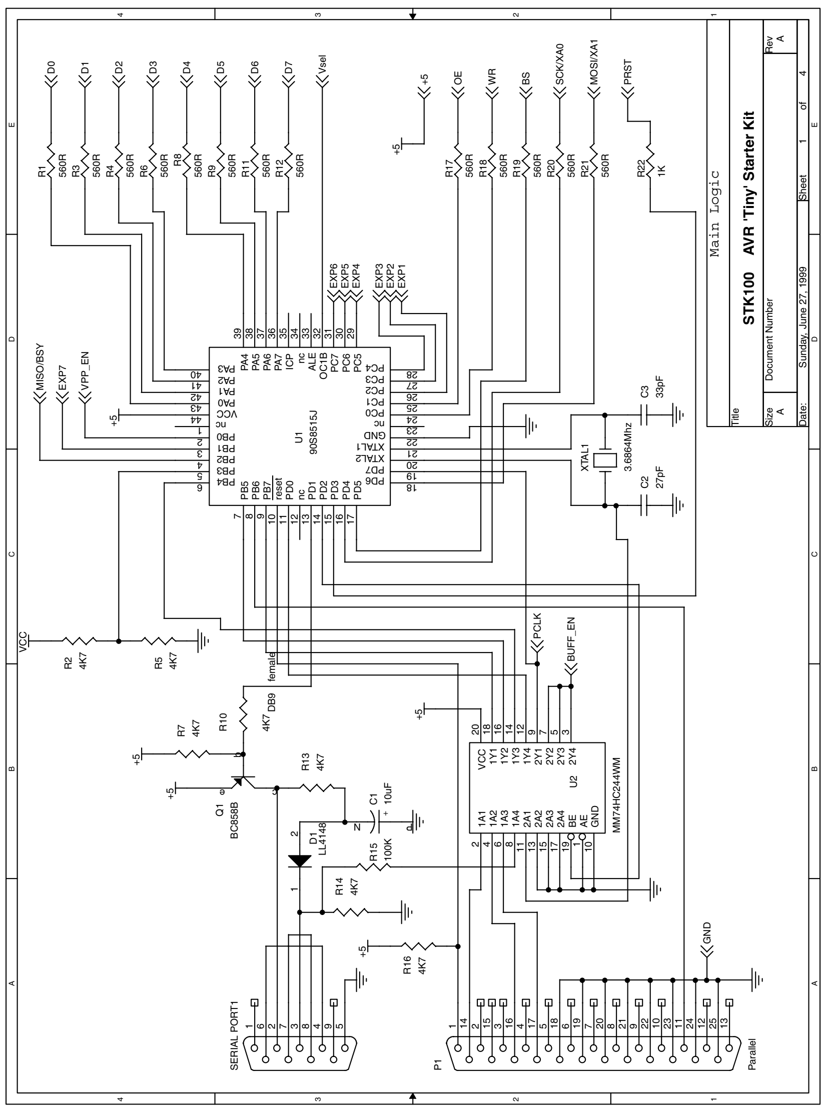


Figure 9-2. Targets and Interfaces Schematic

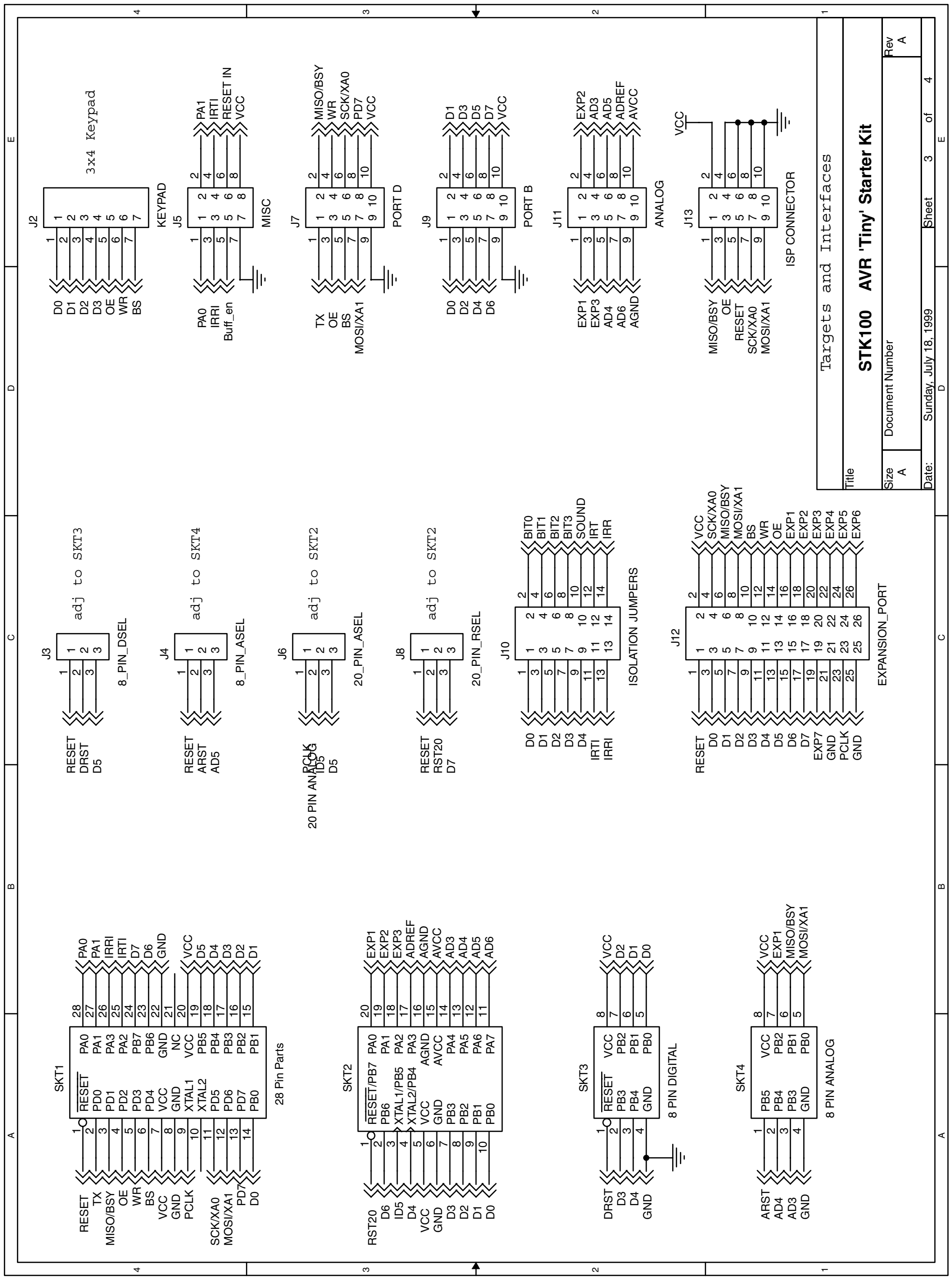
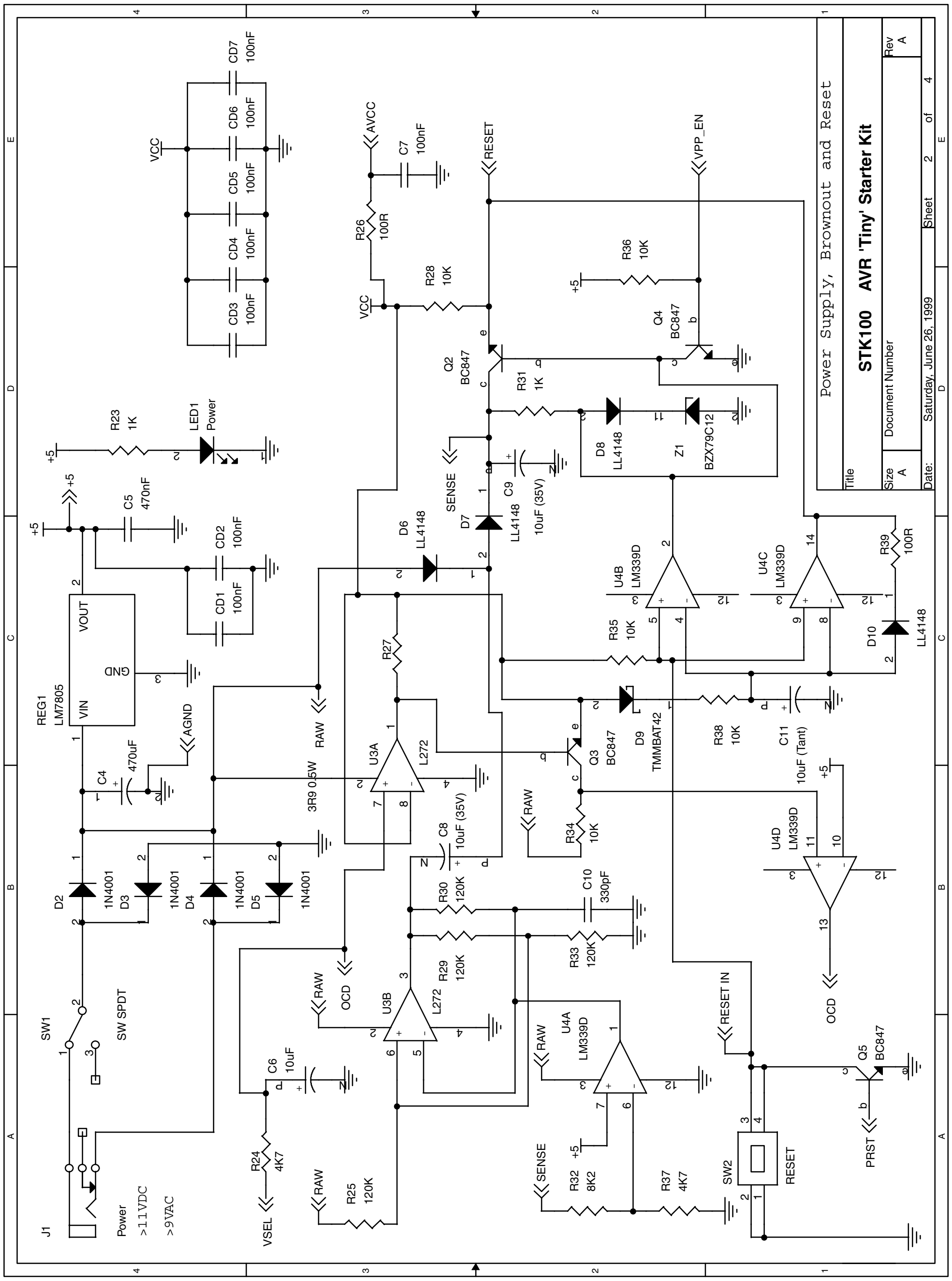


Figure 9-3. Power Supply Schematic



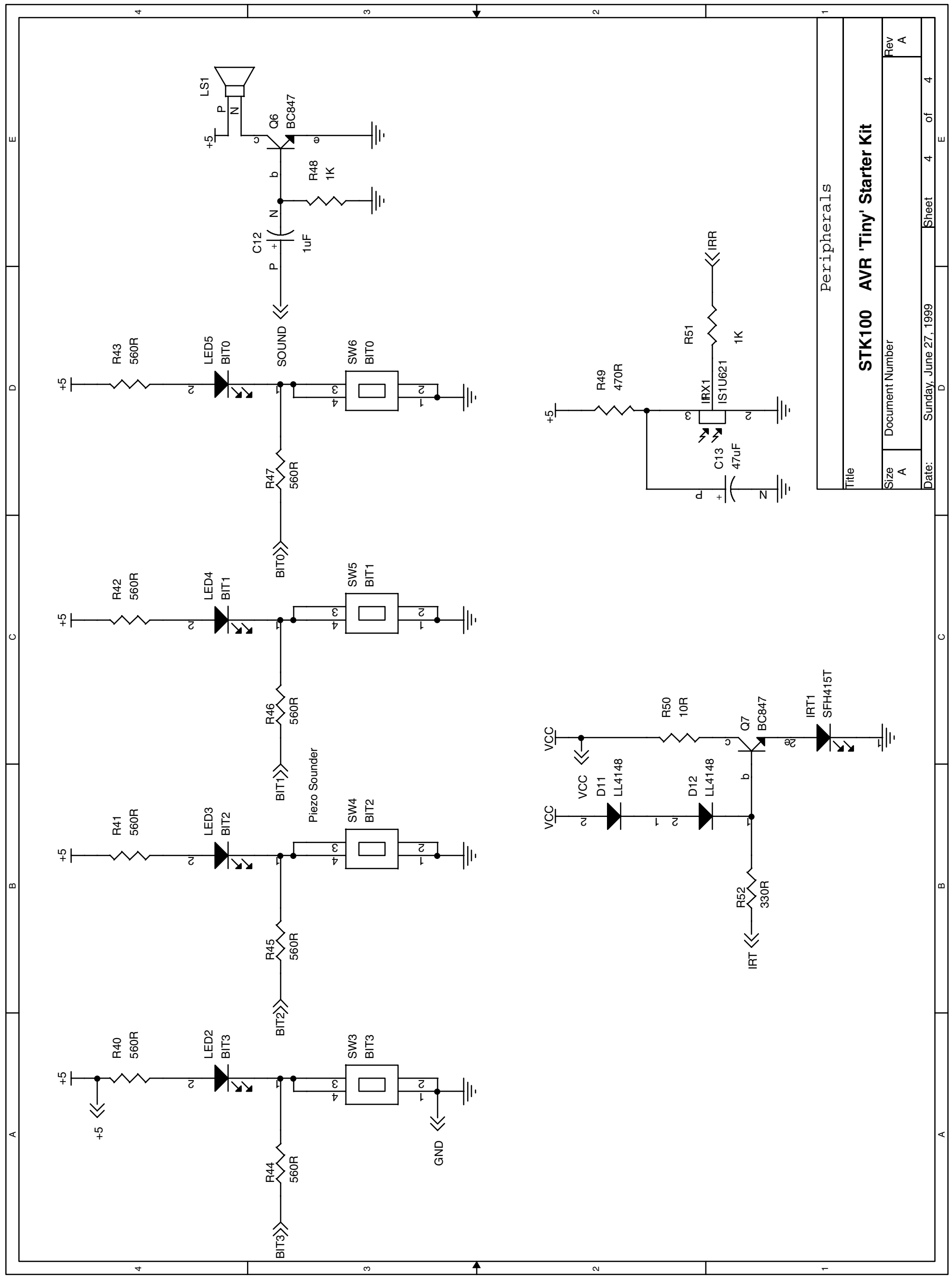


Figure 9-4. Peripheral Schematic

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